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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/805,005	03/18/2004	John Edwin Berberian	10030089-1	7780

7590 02/05/2007

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EXAMINER	
GOODLEY, JAMES E	
ART UNIT	**PAPER NUMBER**
2817	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/05/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/805,005	BERBERIAN ET AL.	
	Examiner	Art Unit	
	James E. Goodley	2817	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/16/2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments, filed 11/16/2006, have been fully considered but they are not persuasive.

The Zhu reference discloses in Figs. 5D and 7 and lines 11-28 of column 12 that by using an AC modulation signal which is superimposed on a DC drive signal to the laser light source, incident light to the quantum absorber will have intensities that are asymmetrical as a function of frequency, about the carrier frequency – as a result of the AC stark shift. Furthermore, lines 8-19 of column 15 clearly discloses that the stark shift detector [261 of Fig. 7] in conjunction with spectrum controller [214] will, "modify the spectrum of the incident light to one that minimizes the magnitude of the total a.c. stark shift." Thus, the Zhu reference does disclose, among other things, the features of claims 1 and 13 in that it discloses reducing asymmetry of the detector signal intensity about the carrier frequency by nature of reducing AC stark shift.

The applicant argues that the detector in Zhu does not exhibit an asymmetry about a center frequency. The applicant points to lines 18-28 of column 12 to argue that a fixed modulation index is chosen (with no servo loop), and the asymmetry is remedied. However, this passage is referring to the behavior of the circuit of Fig. 3, in referring to problems associated with AC stark shift, shown in Fig. 5D. The problems associated with the stark shift in this circuit are remedied by the AC stark shift detector and spectrum control shown in Fig. 7 (again, see lines 8-19 of column 15).

Lines 11-28 of column 4 in Zhu further explain the phenomenon of AC stark shift, in that it causes energy shifts in the ground states and in the excited state. Thus, the circuit of Fig. 7 in Zhu, minimizing the AC stark shift, clearly will alter u_1 and u_0, in order to minimize said asymmetry. Applicant admits that, "The AC stark shift is the dependence of the separation of the two CPT states on the intensity of the light applied to the absorber." Therefore, minimizing the AC stark shift, will alter the CPT energy-state separation and therefore, must alter one of u_1 and u_0, in order to minimize said asymmetry.

The applicant argues the modulator of Zhu does not modulate both intensity and frequency. However, one of ordinary skill in the art knows that intensity (incident energy) of a photon of light, shining on a medium is related to wavelength (and hence, frequency) by the photoelectric effect:

$$hf = \phi + E_{k_{max}}$$

where

- h is Planck's constant,
- f is the frequency of the incident photon,
- $\phi = hf_0$ is the work function, or minimum energy required to remove an electron from atomic binding,
- $E_{k_{max}} = \frac{1}{2}mv_m^2$ is the maximum kinetic energy of ejected electrons,
- f_0 is the threshold frequency for the photoelectric effect to occur,
- m is the rest mass of the ejected electron, and
- v_m is the velocity of the ejected electron.

Finally, one of ordinary skill in the art recognizes the similarities of elements on the periodic table that neighbor each other (for example, IA alkali metals, IIA alkaline earth metals and IIB transition metals). The similarities of the elements in these groups relates to their similar ionization energies. One of ordinary skill in the art understands that these similar ionization energies would translate to similar operational frequencies in a CPT system. Thus, such a person would be motivated to utilize any of the listed isotopes of claims 12 and 23.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-11 and 13-22 are rejected under 35 U.S.C. 102(b) as being anticipated by ***Zhu (of record)***.

Regarding **claims 1-4, 7, 10-11, 13-15, 18 and 21-22**, Fig. 7 and line 14 of column 14 to line 20 of column 15 of Zhu discloses an apparatus comprising:

a quantum absorber [104] comprising a material having first and second low energy states [g1 and g2 shown in Fig. 1] coupled to a common high energy state [e], transitions between said first low energy state and said common high energy state or between said second low energy state being induced by electromagnetic radiation (via laser light injected into the absorber and influence of intensity modulator 260);

an electromagnetic radiation source [laser 102] that generates electromagnetic radiation having first and second CPT-generating frequency components (omega 1 and omega 2 shown in Fig. 2 and in lines 45-56 of column 7), said first CPT-generating frequency component having a frequency $u_L - u$ (where u_L is the average frequency between the g1 and g2 states and $u=\mu/2$; where μ is the frequency difference between the two lower CPT states), and a first CPT component amplitude and said second CPT-generating frequency component having a frequency $u_L + u$ and a second CPT component amplitude, said first and second CPT-generating frequency components irradiating said quantum absorber;

a detector [106] for generating a detector signal [120] related to the power of electromagnetic radiation that leaves said quantum absorber, said detector signal exhibiting an asymmetry as a function of frequency u in a frequency range about a frequency u_0 (see lines 11-28 of column 12 and Fig. 5D);

a CPT servo loop [comprised of freq difference control 110 driving VCO 112 to influence the spectrum controller 214] that alters u in response to said detector signal; and

an asymmetry servo loop [comprised of AC stark shift detector 261] that alters one of u_L, said first CPT component amplitude, and said second CPT component amplitude in a manner that reduces said asymmetry (as per abstract, AC stark shift is reduced - via control signal 265 and spectrum control 214 from AC stark shift servo loop– which inherently alters the first and second ground state energy levels).

Regarding **claims 5 and 6**, Zhu discloses the apparatus of claim 1 wherein said electromagnetic radiation source comprises: a source [laser 102] that generates electromagnetic radiation having a frequency u_L in response to a first signal (output from laser current driver); and a modulator [intensity modulator driven by oscillator control signal 244 to modulate amplitude and freq. difference control loop to modulate frequency at 100Hz from oscillator control signal 142– as per lines 44-58 of column 14].

Regarding **claims 8 and 19**, the lines 15-17 of column 3 of Zhu discloses the apparatus of claim 1 and method of claim 13, wherein said electromagnetic radiation source may comprise first and second phase-locked lasers instead of modulating a single laser.

Regarding **claims 9 and 20**, Zhu discloses the apparatus of claim 1 and method of claim 13, wherein the first and second energy states of said quantum absorber differ in energy by an amount that is a function of the externally applied electromagnetic field from the laser light source.

Regarding **claims 16 and 17**, Fig. 7 of Zhu discloses the method of claim 13, wherein said electromagnetic radiation is generated via modulating the laser frequency at a frequency u about u_L (via carrier frequency control loop).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 12 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over ***Zhu (of record)***.

Regarding **claims 12 and 23**, Zhu discloses the apparatus of claim 10 and method of claim 21 but does not specifically disclose, "wherein said ion is an isotope selected from the group consisting of Be.sup.+, Mg.sup.+, Ca.sup.+, Sr.sup.+, Ba.sup.+, Zn.sup.+, Cd.sup.+, Hg.sup.+, and Yb.sup.+."

Zhu suggests in lines 48-60 of column 12 that Cesium, Rubidium, any other alkali metal, or any other suitable atoms, ions or molecules may be used in the quantum absorber. Since the ions claimed are from group IIA and IIB of the periodic table, these elements have similar properties to the alkali metals of group IA. One of ordinary skill in the art would recognize that the elements may perform similar functions in an atomic frequency standard, but that they differ in their ionization energies, energy level transitions and corresponding frequencies of operation. According to the application at hand, one might choose among these elements based on the desired frequency of operation in a CPT frequency standard.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Zhu by utilizing any of the above isotopes as the quantum absorber instead of Cesium or Rubidium for the purpose of ensuring the desired frequency and energy level transitions for the frequency standard.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James E. Goodley whose telephone number is (571)-272-8598. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Robert J. Pascal can be reached on (571)272-1769. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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